



Primary Arthroplasty

No Difference in Dislocation Seen in Anterior Vs Posterior Approach Total Hip Arthroplasty



Joseph D. Maratt, MD ^{a,*}, Joel J. Gagnier, ND, MSc, PhD ^a, Paul D. Butler, MD ^b,
 Brian R. Hallstrom, MD ^{a,c}, Andrew G. Urquhart, MD ^a, Karl C. Roberts, MD ^d

^a Department of Orthopaedic Surgery, University of Michigan, Ann Arbor, Michigan

^b Grand Rapids Orthopaedic Surgery Residency Program, Grand Rapids, Michigan

^c Michigan Arthroplasty Registry Collaborative Quality Initiative, Ann Arbor, Michigan

^d Department of Surgery, Michigan State University, Grand Rapids, Michigan

ARTICLE INFO

Article history:

Received 6 December 2015

Received in revised form

11 February 2016

Accepted 16 February 2016

Available online 15 March 2016

Keywords:

total hip arthroplasty
 direct anterior approach
 posterior approach
 dislocation
 complication
 outcome

ABSTRACT

Background: The direct anterior approach (DAA) for total hip arthroplasty (THA) has rapidly become popular, but there is little consensus regarding the risks and benefits of this approach in comparison with a modern posterior approach (PA).

Methods: A total of 2147 patients who underwent DAA THA were propensity score matched with patients undergoing PA THA on the basis of age, gender, body mass index, and American Society of Anesthesia classification using data from a state joint replacement registry. Mean age of the matched cohort was 64.8 years, mean body mass index was 29.1 kg/m², and 53% were female. Multilevel logistic regression models using generalized estimating equations to control for grouping at the hospital level were used to identify differences in various outcomes.

Results: There was no difference in the dislocation rate between patients undergoing DAA (0.84%) and PA (0.79%) THA. Trends indicating a slightly longer length of stay with the PA and a slightly greater risk of fracture, increased blood loss, and hematoma with the DAA are consistent with previous studies.

Conclusion: On the basis of short-term outcome and complication data, neither approach has a compelling advantage over each other, including no difference in the dislocation risk.

© 2016 Elsevier Inc. All rights reserved.

Total hip arthroplasty (THA) is generally considered one of the most successful surgical interventions to improve health-related quality of life not only in orthopedics but in all of medicine [1].

Support for the Michigan Arthroplasty Registry Collaborative Quality Initiative is provided by Blue Cross Blue Shield of Michigan and the Blue Care Network as part of the BCBSM Value Partnerships Program.

Although Blue Cross Blue Shield of Michigan and MARCQI work collaboratively, the opinions, beliefs and viewpoints expressed by the authors do not necessarily reflect the opinions, beliefs or viewpoints of BCBSM or its employees.

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to doi: <http://dx.doi.org/10.1016/j.arth.2016.02.071>.

* Reprint requests: Joseph D. Maratt, MD, Department of Orthopaedic Surgery, University of Michigan, A. Alfred Taubman Health Care Center, 1500 East Medical Center Drive, Room 2912, Ann Arbor, MI 48109-5328.

<http://dx.doi.org/10.1016/j.arth.2016.02.071>

0883-5403/© 2016 Elsevier Inc. All rights reserved.

Most patients experience a significant increase in function and mobility, with a decrease in pain, after undergoing THA. However, a minority of patients experience complications secondary to the procedure, with dislocation occurring in 1%–3% [2,3]. In the American Joint Replacement Registry 2014 Annual Report, dislocation was the most frequently reported reason for early revision [4]. Since the inception of THA, efforts have been made to improve the procedure, enhance recovery, and limit complications such as instability, abductor weakness, infection, implant failure, intraoperative fracture, soft tissue injury, and implant wear.

The posterior approach (PA) is the most commonly used approach for THA in the United States. The direct anterior approach (DAA) has rapidly become popular because of perceived improvements in early functional recovery and reduced dislocation rates, with some surgeons advocating for no hip precautions following the procedure [5]. Possible benefits include less soft tissue trauma and a more rapid recovery while maintaining a lower risk of dislocation associated with anteriorly based approaches [6–8]. As

most studies show little difference in functional recovery beyond 6 weeks between the 2 approaches, dislocation risk remains one of the main reasons for advocating the anterior approach. However, there is concern over a high prevalence of numbness from injury to the lateral femoral cutaneous nerve, in addition to a potentially overall higher risk of complications during a surgeon's "learning curve" [9–12]. Modern PAs with repair of the capsule have demonstrated comparable dislocation rates to DAA THA [13–15], and the short-term functional benefit of the DAA may not be as significant as once thought when patients are risk matched within a cohort and undergo contemporary perioperative protocols [16]. Much of the comparative literature is limited to smaller numbers of patients, single-surgeon series, and experienced surgeons beyond their learning curve at high-volume centers; thus, the literature may not reflect the actual results seen in the spectrum of clinical settings.

The Michigan Arthroplasty Registry Collaborative Quality Initiative (MARCQI) is a statewide joint arthroplasty registry with abstracted and validated data capturing greater than 90% of primary total hip and knee arthroplasties done in the state with 98.5% completeness of data [17].

Our goal was to compare short-term outcomes and complications between the direct anterior and PAs for THA in the state of Michigan by using data from the MARCQI joint registry. The primary outcome of interest was dislocation. Secondary outcomes of interest included other parameters thought to be affected by surgical approach, including fracture, blood loss, transfusion, hematoma formation, length of stay, and readmission.

Methods

A retrospective analysis of MARCQI data was performed. MARCQI is a Blue Cross Blue Shield of Michigan and Blue Care Network supported collaborative enrolling its first patients in 2012. Participation in MARCQI is a requirement of the Blue Distinction Center of Excellence for Knee and Hip Surgery. All the 59 hospitals in the state of Michigan performing greater than 200 hip or knee arthroplasty procedures annually are now recruited and participating in the collaborative.

MARCQI collects level I, II, and III data using a combination of manual abstraction from the medical record, administrative data uploads, and device information uploads with rigorous auditing and data validation. Data elements include demographic data, including name and Social Security number, details of the operative intervention, implants used, 90-day adverse events, comorbidities, venous thromboembolism prophylaxis, and perioperative laboratory data. Completeness of level I and II data is 98.5% [17].

The registry was queried for all patients undergoing unilateral primary THA utilizing a DAA or PA between February 2012 and September 2014. During the study period, 42 participating hospitals submitted 15,424 primary THAs to the registry. The numbers of DAA and PA surgeries performed were 2156 (14.0%) and 8956 (58.0%), respectively. An anterolateral approach was used in 3918 (25.4%) cases. Other approaches were used in 283 (1.8%) cases, and the approach was unknown or missing in 139 (0.9%) cases. Information retrieved for each case included demographic data, operative variables, and 90-day adverse event data.

Patients who underwent DAA THA were propensity score matched with patients undergoing PA THA on the basis of age, gender, body mass index and American Society of Anesthesia classification favoring exact matches and without replacement. Cases with missing match parameters were excluded (9 [0.42%] DAA, 45 [0.50%] PA) from matching. From the cases eligible for propensity score matched (11,112), 2147 matched pairs were

Table 1

Propensity Score Matched PA and DAA Cohort Baseline Comparisons.

	PA		DAA		95% CI ^a
	Mean	Standard Deviation	Mean	Standard Deviation	
Age	64.84	12.08	64.36	10.93	−0.21 to 1.17
Height	169.79	10.30	169.61	10.13	−0.03 to 2.24
Weight	84.85	18.36	83.75	19.53	−0.43 to 0.80
BMI	29.30 ^b	5.01	28.97 ^b	5.51	0.01–0.64
	n	%	n	%	
Female	1117	52.0	1169	54.0	
ASA I	74	3.4	71	3.3	
ASA II	1322	61.6	1269	59.1	
ASA III	721	33.6	770	35.9	
ASA IV	30	1.4	37	1.7	

PA, posterior approach; DAA, direct anterior approach; CI, confidence interval; BMI, body mass index; ASA, American Society of Anesthesia.

^a 95% Confidence interval of the difference.

^b Statistical significance was reached at the 0.05 level.

identified. Mean age of the matched cohort was 64.8 years, mean body mass index was 29.1 kg/m², and 53% were female. A comparison of the match parameters was performed to confirm that the groups were comparable (Table 1).

Multilevel logistic regression models using generalized estimating equations to control for grouping at the hospital level were used to identify differences in various outcomes for the predictor variable of DAA vs PA. We selected generalized estimating equation correlation structures by testing each and selecting the structure with the smaller Quasi Akaike Information Criterion value separately for all models. Incidence risk ratios and 95% confidence intervals were calculated for each outcome variable of interest: dislocation, fracture recognized intraoperatively, fracture recognized postoperatively, hematoma, length of stay, duration of surgery, change in hemoglobin level, transfusion, and readmission.

Our study was powered ($1 - \beta > 0.80$) to detect a difference of 1% with a baseline risk of 0.8%. The threshold for statistical significance was $\alpha < 0.05$. SPSS (v22.0.0.0, IBM, Armonk, NY) and Stata (v14.0, StataCorp, College Station, TX) software packages were used in the analysis.

Results

There was no difference in the rate of dislocation based on approach (0.84% DAA vs 0.79% PA, incidence rate ratio = 1.06, $P = .88$). There was an increase in procedure duration with the DAA (100.94 ± 38.00 min DAA vs 76.35 ± 27.72 min PA, incidence rate ratio = 1.32, $P < .05$). There were no statistically significant differences in fracture rate, blood loss, transfusion, hematoma, length of stay, or readmission (Table 2). There were trends toward a longer length of stay in the PA group and greater risk of fracture, increased blood loss, and hematoma in the DAA group (Table 2).

Discussion

Our results demonstrate no significant differences in dislocation rates or early outcomes between the anterior and posterior surgical approaches when performing primary THA.

Surgeon preference, training, experience, perceived risks and benefits of each approach, patient preference, and the influence of direct-to-consumer marketing all play a role in selection of approach for THA. Analysis of data from the MARCQI joint registry representing greater than 90% of all primary THAs done in Michigan with more than 22,907 THA cases recorded since 2012

Table 2
Regression Analysis of PA and DAA Outcomes and Complications.

	PA		DAA		IRR	P ^a	95% CI
	n	%	n	%			
Dislocation	17	0.79	18	0.84	1.06	.88	0.48–2.35
Fracture—postop	24	1.12	31	1.44	1.30	.31	0.78–2.14
Fracture—intraop	26	1.21	21	0.98	0.81	.56	0.40–1.65
Hematoma	27	1.26	43	2.00	1.60	.20	0.78–3.28
Hematoma—I&D	6	0.28	11	0.51	1.84	.16	0.79–4.30
Blood transfusion	208	9.69	173	8.06	1.01	.28	0.99–1.09
Readmission—90 d	117	5.45	109	5.08	0.94	.53	0.76–1.15
	Mean	Standard Deviation	Mean	Standard Deviation	IRR	P ^a	95% CI
Hemoglobin change (g/dL)	3.62	1.20	3.74	1.20	1.03	.21	0.75–1.15
LOS (d)	2.54	1.28	2.37	1.41	0.93	.28	0.82–1.06
Procedure duration (min)	76.35	27.72	100.94	38.00	1.32	<.05	1.19–1.46

PA, posterior approach; DAA, direct anterior approach; CI, confidence interval; LOS, length of stay; IRR, incidence rate ratio.

^a Significance value for the IRR.

shows use of the PA in 56%, anterolateral in 26%, and DAA in 17% of cases. Data from the Kaiser Permanente Total Joint Replacement Registry show similar trends, with 75% of cases using the PA, 12% using lateral approaches, and only 4% using the DAA from 2001 to 2011 [8].

Although the anterior approach is less commonly performed, it has been gaining popularity because of perceived benefits of faster recovery, potentially decreased dislocation rates compared to the PA, and use of a muscle-sparing technique. However, there is a concern for increased complications in the learning curve and higher risk of early revision [12]. The PA has been widely popular because of its familiarity to surgeons, ease of extension for complex or revision cases, and preservation of the hip abductors to avoid the occurrence of a limp. There is concern over injury to the sciatic nerve with the PA; this is a rare complication reported in 0.17% of 27,004 THAs by Farrell et al [18]. Nerve injury is not unique to the PA, as Goulding et al [10] reported an 81% incidence of lateral femoral cutaneous nerve deficits after direct anterior THA, but the clinical significance of this on outcomes is debated. There are conflicting data regarding the benefits in early recovery period and complications between the anterior and PAs [6,7,16]. The most compelling reason to advocate for the anterior approach remained the potentially decreased risk of dislocation.

However, much of the comparative data reporting higher dislocation rates for the PA are historic [3,14,19]. Modern PAs with capsular repair, and potentially the use of larger femoral heads, have decreased the risk of dislocation to a level that may be comparable to that of the DAA [13,14,20–22].

Sheth et al [8] recently reported their results from a similar regional joint registry (Kaiser Permanente Total Joint Replacement Registry) and showed the anterior and anterolateral approaches had lower risks of dislocation compared to the PA, with no difference in rates of revision in a review of 22,237 patients. They found no differences in outcomes when comparing the DAA and the anterolateral approach [8].

Our results contradict these findings, showing no difference in dislocation rates between the DAA and the PA. A possible explanation for this discrepancy is that our cases in both the DAA and PA groups are more recent, and therefore, more likely to use modern techniques such as posterior capsular repair, increased offset stems, and larger femoral head sizes that could have a positive effect on reducing dislocation rates. Other studies also have failed to

demonstrate a difference in dislocation rates between the DAA and PA [6,7,16].

Our results report dislocation rates that are comparable to the literature for posterior and anterior approaches (PA 0.79% and DAA 0.84%) [5,13,23].

This study has many limitations common to observational research. Patients were not randomly assigned to treatment. Inherent differences in prognosis might influence the surgeon's decision to use any given approach and result in biased estimates of the associations. Surgeon experience and volume can impact outcomes for any given procedure, and these factors were not controlled in this study. For these reasons, it is a challenge to separate the effect of the approach from patient, hospital, and surgeon effects.

Our results also showed a slightly higher change in hemoglobin with the DAA but a greater rate of transfusions in the PA group. This inconsistency demonstrates the variability in practice patterns and adherence to current guidelines that may be clustered within a subgroup.

In addition, implant information including head size was not yet available from MARCQI for this data set. Variations in the use of larger femoral heads may influence the results but were not included in this analysis. If surgeons using one approach were more likely to use large heads this could affect the results, but this effect may be eliminated given the large data set and broad experience of the surgeons across the state.

Our results confirm that the direct anterior and PAs have similar outcomes in THA with respect to dislocation and clinical complications, and surgeons should choose an approach on the basis of level of training, experience, and patient preference.

Conclusion

Short-term outcome and complication data from a state joint replacement registry demonstrates that THA performed using either the DAA or PA have no compelling advantage over each other, including no difference in the dislocation risk.

References

- Ethgen O, Bruyère O, Richey F, et al. Health-related quality of life in total hip and total knee arthroplasty. A qualitative and systematic review of the literature. *J Bone Joint Surg Am* 2004;86-A:963.
- Khatod M, Barber T, Paxton E, et al. An analysis of the risk of hip dislocation with a contemporary total joint registry. *Clin Orthop Relat Res* 2006;447:19.
- Palan J, Beard DJ, Murray DW, et al. Which approach for total hip arthroplasty: anterolateral or posterior? *Clin Orthop Relat Res* 2009;467:473.
- Second AJRR annual report on hip and knee arthroplasty data. Rosemont, IL: American Joint Replacement Registry; 2015.
- Restrepo C, Mortazavi SMJ, Brothers J, et al. Hip dislocation: are hip precautions necessary in anterior approaches? *Clin Orthop Relat Res* 2010;469:417.
- Barrett WP, Turner SE, Leopold JP. Prospective randomized study of direct anterior vs postero-lateral approach for total hip arthroplasty. *J Arthroplasty* 2013;28(9):1634.
- Rodríguez JA, Deshmukh AJ, Rathod PA, et al. Does the direct anterior approach in THA offer faster rehabilitation and comparable safety to the posterior approach? *Clin Orthop Relat Res* 2013;472:455.
- Sheth D, Cafri G, Inacio MCS, et al. Anterior and anterolateral approaches for THA are associated with lower dislocation risk without higher revision risk. *Clin Orthop Relat Res* 2015;1.
- De Geest T, Vansintjan P, De Loore G. Direct anterior total hip arthroplasty: complications and early outcome in a series of 300 cases. *Acta Orthop Belg* 2013;79:166.
- Goulding K, Beaulé PE, Kim PR, et al. Incidence of lateral femoral cutaneous nerve neuropraxia after anterior approach hip arthroplasty. *Clin Orthop Relat Res* 2010;468:2397.
- Jewett BA, Collis DK. High complication rate with anterior total hip arthroplasties on a fracture table. *Clin Orthop Relat Res* 2010;469:503.
- Spaans AJ, van den Hout JAAM, Bolder SBT. High complication rate in the early experience of minimally invasive total hip arthroplasty by the direct anterior approach. *Acta Orthop* 2012;83:342.

13. Browne JA, Pagnano MW. Surgical technique: a simple soft-tissue-only repair of the capsule and external rotators in posterior-approach THA. *Clin Orthop Relat Res* 2011;470:511.
14. Pellicci PM, Bostrom M, Poss R. Posterior approach to total hip replacement using enhanced posterior soft tissue repair. *Clin Orthop Relat Res* 1998;224.
15. Siguier T, Siguier M, Brumpt B. Mini-incision anterior approach does not increase dislocation rate: a study of 1037 total hip replacements. *Clin Orthop Relat Res* 2004;164.
16. Poehling-Monaghan KL, Kamath AF, Taunton MJ, et al. Direct anterior versus miniposterior THA with the same advanced perioperative protocols: surprising early clinical results. *Clin Orthop Relat Res* 2014;473(2):623.
17. Hughes RE, Hallstrom BR, Cowen ME, et al. Michigan Arthroplasty Registry Collaborative Quality initiative (MARCQI) as a model for regional registries in the United States. *Orthopaedic Res Rev* 2015;7:47.
18. Farrell CM, Springer BD, Haidukewych GJ, et al. Motor nerve palsy following primary total hip arthroplasty. *J Bone Joint Surg Am* 2005;87:2619.
19. Woo RY, Morrey BF. Dislocations after total hip arthroplasty. *J Bone Joint Surg Am* 1982;64:1295.
20. Amlie E, Hovik O, Reikerås O. Dislocation after total hip arthroplasty with 28 and 32-mm femoral head. *J Orthop Traumatol* 2010;11:111.
21. Bistolfi A, Crova M, Rosso F, et al. Dislocation rate after hip arthroplasty within the first postoperative year: 36 mm versus 28 mm femoral heads. *Hip Int* 2011;21:559.
22. Ho KWK, Whitwell GS, Young SK. Reducing the rate of early primary hip dislocation by combining a change in surgical technique and an increase in femoral head diameter to 36 mm. *Arch Orthop Trauma Surg* 2012;132:1031.
23. Hailer NP, Weiss RJ, Stark A, et al. The risk of revision due to dislocation after total hip arthroplasty depends on surgical approach, femoral head size, sex, and primary diagnosis. *Acta Orthop* 2012;83:442.